COLORADO WATER RESOURCES

by

CLIFFORD H. STONE, *Director*
Colorado Water Conservation Board

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1950

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(The information in this booklet is an advance release of the contents of the chapter on "Colorado Water Resources" to appear in the COLORADO YEAR-BOOK, published by the Colorado State Planning Commission).

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Publication Approved by James A. Noonan, State Controller

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INTRODUCTORY

Colorado citizens are concerned about the State's water resources. Generally they realize that water is a key to the future, but relatively few of them are informed about the nature and extent of the program which is carried on by the Colorado Water Conservation Board to develop these vital resources. Significant progress has been made since 1937 when the Water Board was created by the General Assembly.

In recognition of these facts, the Colorado State Planning Commission is devoting more space than in previous issues to "Colorado Water Resources" in its "1948-50 Year Book," and the director of that commission, W. M. Williams, has granted to the Colorado Water Conservation Board the privilege of printing a pre-publication release of the chapter on water resources. The opportunity thus afforded to present the report of the Director of the Water Board in this pamphlet form is gratefully acknowledged.

The material contained herein does not purport to cover every phase of the State's water problems and plans for development. It does present, among other things, a thumb-nail sketch of the extent of the water resources of the State, a brief statement of interstate relations, the status of water project authorization and construction, a description of completed Federal projects and those under construction, a summation of the present Federal water development program in the State which aggregates $326,487,884 in cost, a short review of the activities of the Bureau of Reclamation and the Army Engineers in Colorado, and a somewhat detailed review of present surveys and investigations now underway for the formulation of a plan for the utilization, conservation, and control of Colorado's remaining unused water resources. Problems and programs incident to the comprehensive development of the Upper Colorado, Missouri, and Arkansas River Basins are also briefly reviewed.

CLIFFORD H. STONE, Director
Colorado Water Conservation Board

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EDITORS NOTE—*Water is so basic and vital to Colorado's present well-being as well as her future growth that it is considered most appropriate to present in this Year Book a comprehensive coverage of water resources development in Colorado in recent years and the program for further development as contained in the following authoritative article prepared by Judge Clifford H. Stone who has worked aggressively and continuously for many years in behalf of Colorado's water interests.*

FOREWORD

The sources of six major rivers are found in the State of Colorado. These are the Colorado, the Rio Grande, the Arkansas, the South Platte, the North Platte and the Republican Rivers. The North and South Platte Rivers and the Republican River are tributaries which contribute streamflows to the Missouri River. Thus there lie in Colorado portions of four major river basins, viz: The Colorado, Rio Grande, Arkansas and Missouri Basins.

The State of Colorado is bisected by the Continental Divide. Thirty-seven per cent of the total area of the State lies west, and 63 per cent east, of this mountain range. Within the State is found 75 per cent of the area in the United States with an elevation of 10,000 feet or more above sea level. There are fifty-two peaks within the Centennial State's borders with an elevation of over 14,000 feet. The areas above the altitude of 9,000 feet are those most productive of surface water runoff in spring and summer months. As a result of this topographic feature with high areas of heavier precipitation, water produced in Colorado's high mountains flows out in all directions into adjoining states and beyond.

Surface Water Yields in Colorado

The total water precipitated on the 66,718,080 acres within the boundaries of Colorado, at the weighted average rate of 17.8 inches, amounts to approximately 99,000,000 acre-feet in a year of normal climatic conditions. The surface streamflows originating in the State, measured or estimated at the points where the streams leave Colorado at the State boundaries, have aggregated 12,440,000 acre-feet in an average year of the period 1914-1945. Streamflow depletions, chargeable to man's activities in the use of water for domestic, irrigation and related purposes in the State, have been estimated to average about 4,200,000 acre-feet annually over the same period.

Thus the surface water yield in Colorado, over and above natural losses, available for utilization, amounts to 16,640,000 acre-feet in an average year. This is about 17 per cent of the total water precipitated on the area of the State in such a year. The remaining 83 per cent of the precipitated water is returned to the atmosphere by the natural processes of evaporation from soil surfaces and from water surfaces in stream channels, natural lakes or ponds, and by transpiration from native vegetation. Minor quantities are also lost through deep percolation. The studies on which these figures are based indicate that after more than 80 years of progressive irrigation development in Colorado, the stream depletions due to man's activities are about 25 per cent of the physically available water yield. Some of these streamflows which are physically available must be passed over the state lines to other states to fulfill the equitable apportionments of the use of the waters of interstate rivers.

Western Colorado, with 37 per cent of the total State area, has 69 per cent of the State's surface water yield, and that part of the State east of the Continental Divide, with 63 per cent of the total area, has but 31 per cent of such water resources.

In general, the streamflows originating east of the Continental Divide are over-appropriated. The remaining unappropriated surface waters of the State are found in the Colorado River Basin. Accordingly, it has been well said that the Colorado River Basin is the State's last "water hole" for future development.

Surface Water Inflow Into Colorado

It often has been incorrectly stated that Colorado receives no streamflows from other states. Although very small as compared with the surface water

yield originating in the State, surface water inflow into the State is estimated to amount to approximately 500,000 acre-feet in an average year. This inflow is exclusive of the Green River with flows into and out of the State within a short distance, and also is exclusive of the San Juan River which flows into and out of the State at the "four corners," the point where the boundary lines of Colorado, New Mexico, Utah and Arizona meet; it is inclusive of that part of the surface water yield of the Little Snake River which originates in Wyoming.

Water Supplies Limiting Factor in Development

The availability of surface water supplies is a limiting factor in the agricultural and industrial development of the State. In general, as stated above, the remaining unappropriated surface waters of the State, which its citizens are entitled to use, are found in the Colorado River Basin; and, in the end, the best protection of such limited water supplies lies in their actual utilization. It is no exaggeration to say that such development is a key to the future progress, prosperity and economic welfare of this inland empire. *Additional water supplies are needed for expansion of crop acreage and for inadequately irrigated land, for ever-increasing requirements to meet domestic and industrial purposes, and for hydroelectric production. The preservation and protection of fish and wildlife and recreational values are also related to water development.* Flood control, watershed protection, soil conservation and land management, and investigation and utilization of underground water supplies are likewise phases of development which enter into programs for water conservation and utilization.

The day of cheap and easily constructed water projects is largely in the past. The works and improvements of the present time require large expenditures of money. They must be built under repayment terms and conditions which will not impose an undue burden on their beneficiaries. Then, too, an era has been reached when all river basin water development in its major aspects must be integrated. In short, the time has come to "cut the final pattern" for the best use of this vital resource—water.

In view of this situation, it is necessary for the State to work in close cooperation with Federal agencies, which participate in water development, with local affected groups and interests within the State, and with other affected states within particular river basins. Major questions and policies which relate to the Federal water program are vital matters, in which the State must interest itself. It is a broad field which in the case of the United States-Mexico Water Treaty extended into international relations.

Under present law the State must review, comment upon, and make recommendations on the reports of Federal agencies for proposed projects before they can be authorized for construction. This makes it necessary for the State to appraise and inventory its water resources, to develop overall plans and programs and to aid in the adjustment of interstate problems.

INTERSTATE WATER RELATIONS

General: Because the origins of so many major rivers are found in Colorado, the utilization of its surface water supplies has created many interstate problems. Under the principle of equitable apportionment of the use of the waters of interstate rivers, Colorado in the past became a party to more interstate litigation over water controversies before the Supreme Court of the United States than any other state.

The controversy between Kansas and Colorado started in 1901 over the use of the waters of the Arkansas River. The first case was decided in 1907 (Kansas v. Colorado, 206 U. S. 41). Litigation on this river continued. The second case was decided by the U. S. Supreme Court on December 6, 1943 (Colorado v. Kansas, 320 U. S. 383).

The case of Hinderlider v. La Plata River and Cherry Creek Ditch Company, 304 U. S. 92, involved the validity of the La Plata River Compact between Colorado and New Mexico.

Six decisions of the U. S. Supreme Court have been rendered with respect to the Laramie River. These involved Colorado and Wyoming. The North Platte River litigation in the U. S. Supreme Court, among Nebraska, Wyoming and Colorado, resulted in the decision of the court in 1945. (Nebraska v. Wyoming and Colorado, United States Intervener, 325 U. S. 509).

In the light of this experience in interstate water litigation, Colorado has adopted the policy, strongly supported by the Colorado Water Conservation Board, of seeking amicable adjustments, if possible, of interstate water controversies by compacts and other means. At the present time no interstate litigation over water, in which Colorado is interested, is pending. Even before the last U. S. Supreme Court case was finally settled, the State became actively engaged in negotiating water compacts.

Colorado Compacts: The State is now a signatory to eight interstate water compacts. These compacts, together with decisions and decrees of the Supreme Court of the United States, cover every major river of the State and some of their tributaries. These compacts are:

Colorado River Compact: (Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming). Signed November 24, 1922; effective date, June 25, 1929; not effective as to Arizona until 1944.*

La Plata River Compact: (Colorado and New Mexico). Signed November 27, 1922; effective date, January 29, 1925.

South Platte River Compact: (Colorado and Nebraska). Signed April 27, 1923; effective date, March 8, 1926.

Rio Grande Compact: (Colorado, New Mexico and Texas). Signed March 18, 1938; effective date, March 31, 1939.

Republican River Compact: (Colorado, Kansas and Nebraska). Signed December 31, 1942; effective date, May 26, 1943.

Costilla Creek Compact: (Colorado and New Mexico). Signed September 30, 1944; effective date, June 11, 1946.

Upper Colorado River Basin Compact: (Arizona, Colorado, New Mexico, Utah and Wyoming). Signed October 11, 1948; effective date, April 6, 1949.

Arkansas River Compact: (Colorado and Kansas). Signed December 14, 1948; effective date, May 31, 1949.

Upper Colorado River Commission: Since the Upper Colorado River Compact deals with the remaining unappropriated water available for use in Colorado and such use is basic in the State's future development, its consummation is of great significance. In a political and governmental sense it indicates the decision of five states to work together for the purpose of solving important economic problems. The Compact created the Upper Colorado River Commission. As an official interstate body, this Commission, in accordance with the express terms of the Compact, is in the unique position of being able to expedite basinwide development, to aid in shaping such development and to be of material assistance in the integration of Federal and State activities and interests.

This Commission is composed of five members, one each for the states of Colorado, New Mexico, Utah and Wyoming and one, appointed by the President, for the Federal government. The present members of the Commission are: Harry W. Bashore for the United States; Clifford H. Stone for Colorado; John H. Bliss for New Mexico; Joseph M. Tracy for Utah; and L. C. Bishop for Wyoming. Arizona is not represented on the Commission because of its relatively small interest in the waters of the Upper Basin.

Organization of the Commission has been completed. Headquarters were established at Grand Junction, Colorado, in January 1950. J. G. Will has been appointed Executive Secretary and General Counsel, and Ralph D. Goodrich has been selected as Chief Engineer. The By-Laws of the Commission, provide for an annual meeting on the third Monday of September, and a regular meeting on the third Monday of March. Special meetings may be called by the Chairman. The expenses of the Commission are borne by the member states in proportion to the apportionment of water under the compact.

Arkansas River Compact Administration: Article VIII of the Arkansas River Compact creates the Arkansas River Compact Administration. It is charged with administering the provisions of the Compact. This body consists

*(By "effective date," as used above, is meant the date when the Act of Congress, giving consent to a compact, was signed by the President of the United States. A compact becomes effective only after it has been ratified by the legislatures of the signatory states and consented to by an Act of the Congress.)

of seven members. Three of them represent Colorado, three represent Kansas, and one member, Brig. Gen. Hans Kramer, represents the United States. The Colorado members are Harry B. Mendenhall, Harry C. Nevius, and Clifford H. Stone, as Director of the Colorado Water Conservation Board; and the Kansas members are George S. Knapp, William E. Leavitt, and Roland H. Tate.

The Administration was organized on July 22, 1949, and headquarters have been established at Lamar, Colorado. The Federal representative, in accordance with the provisions in the compact, is chairman of the Administration and Harry C. Nevius of Lamar is Secretary-Treasurer.

The compact provides that one of the Colorado representatives shall be a resident and water right owner in Water District 14 or 17; one shall be a resident and water right owner in District 67, and the third shall be the Director of the Colorado Water Conservation Board. The Administration adopted rules and regulations which became effective on April 15, 1950. Under the by-laws three meetings a year are held, of which one is the annual meeting held on the second Tuesday in December. Special meetings may be called by the Chairman. The Administration is financed by the two signatory states on the basis of 60 per cent paid by Colorado and 40 per cent by Kansas.

Rio Grande Compact Commission: Article XII of the Rio Grande Compact created the Rio Grande Compact Commission to administer the terms of the compact. The Commission consists of four members. The State Engineer of Colorado is ex-officio commissioner for Colorado; the State Engineer of New Mexico is ex-officio commissioner for New Mexico; and the commissioner for Texas is appointed by the Governor of that State. The President of the United States appoints a Federal representative who acts as Chairman of the Commission without vote. The salaries and expenses of the commissioners are paid by the respective states which they represent and all other expenses incident to the administration of the compact, not borne by the United States, are paid equally by the three states.

Certain specific powers and duties conferred upon the Commission have to do with the administration of the compact. These include the collection, correlation, and presentation of factual data and the maintenance of records bearing upon compact administration. The Commission by unanimous action may make recommendations to the respective states. The Commission employs a secretary whose duties are to collect and correlate factual data for the Commission.

WATER RIGHTS AND THEIR ADMINISTRATION

The Colorado Constitution, Article XVI, Sec. 5, provides that:

> "The water of every natural stream, not heretofore appropriated, within the State of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriation as hereinafter provided."

Section 6 of the same article specifies that the right to divert the unappropriated waters of any natural stream to beneficial use shall never be denied and that priority of appropriation shall give the better right as between those using the water for the same purpose. This same section directs that when the waters of any natural stream are not sufficient to serve all those desiring the use of the same, those using the water for a domestic purpose shall have the preference over those claiming for an irrigation purpose, and those using the water for agricultural purposes shall have preference over those claiming it for manufacturing purposes. This preference right has been construed by the courts to mean that a vested right in water for irrigation cannot be taken for the preferred domestic purposes except by condemnation.

By the adoption of the appropriation doctrine under the Constitution, the only rights which exist in water in its natural state in Colorado are rights of use. Such right is not in the ownership of the corpus of water, but springs from the legal privilege to use it.

A water right in Colorado is acquired by placing water to a beneficial use. The State statutes provide for judicial determination of rights to the use of water, and a decree rendered by the court is evidence of particular rights.

The State Engineer is charged with the administration of the distribution of water in Colorado in accordance with rights therein acquired under State law. In the section on State Government in this issue of the Year Book appears a description of the functions, duties and organization of the State Engineer's office.

COLORADO WATER CONSERVATION BOARD

The Colorado Water Conservation Board was created by Statute in 1937. Its functions may be roughly classified as follows:

1. To appraise and inventory the State's water resources and develop programs for their conservation, utilization and control; (2) to formulate and further a continning State policy with respect to water development programs and problems, both intrastate and interstate; (3) to promote water projects and in connection therewith conduct investigations, make surveys and studies, and review and make official State comments upon project reports of Federal agencies; (4) to aid and collaborate with local affected interests and consult with other interested State agencies and Federal agencies in all matters relating to the Federal water development program; (5) to handle interstate water relations and problems, including the furnishing of engineering service to the Attorney General in interstate litigation over water; and to render aid and assistance, engineering and otherwise, to negotiating and administrative compact commissions; (6) and generally to aid in the conservation, beneficial utilization, development, and protection of the water resources of Colorado in the interest of the present and future welfare of the State and its citizens.

The Colorado Water Conservation Board consists of fourteen members. The Governor is an ex-officio member and chairman. Other ex-officio members are the Attorney General, the State Engineer, the Director of the State Planning Commission, and the Director of the Colorado Water Conservation Board. The remaining nine members are appointed by the Governor and serve for three-year, staggered terms. Four of these members are appointed from Western Colorado, four from Eastern Colorado, and one from the San Luis Valley, in the Upper Rio Grande Basin. Of the four members from Western Colorado, one is appointed from the San Juan Basin, one from the Gunnison and Uncompahgre Basins, one from the main stem of the Colorado River, and one from the White-Yampa Basin area. Of the four appointed from Eastern Colorado, one is appointed from the Arkansas Basin, one from the South Platte Basin, one from the the North Platte Basin, and one from the City and County of Denver.

In order to carry on its work the Board maintains an engineering staff. The executive officer of the Board is the Director, who is also responsible for representing the Board and the State in various contacts with other states, with Federal agencies, and with water interests throughout the State. He is called upon to appear at various water hearings, including those conducted by Committees of the Congress.

UNDERGROUND WATERS.

In 1945 an investigation was begun of the nnderground-water resources of Colorado. The Legislature, in 1945 and again in 1947 and 1949, made available to the Colorado Water Conservation Board $25,000 for each biennium to carry on this work. The Board entered into biennial cooperative contracts for making these investigations with the Ground Water Branch of the United States Geological Survey, which agency contributes an amount equal to that paid by the State. The work is carried on by specialists of the Geological Survey in areas specified by the Board after consultation with local interests and the Geological Survey.

The vast underground-water supplies of the State constitute an invaluable resource. Their proper development and utilization, however, are dependent to a major extent upon the painstaking gathering, study, and interpretation of factual information. Such factual data also will serve as a necessary backgrounnd for any State ground-water code that ultimately may be enacted. Many states, including all those adjacent to Colorado, have been conducting ground-water investigations for many years.

Through the close of 1949 several major ground-water investigations were completed, others were in progress, and many minor studies have been made

for cities, towns, and other local areas where emergency problems had arisen. A report on the Big Sandy Creek area in Elbert, El Paso, and Lincoln Counties was published by the Board in 1946.

A detailed investigation of the sump area of the closed basin in the San Luis Valley has been completed, and the results will be incorporated with those being obtained from a study of the irrigated area of the valley. The San Luis Valley studies have been carried on by the Board, the U. S. Geological Survey, and the Bureau of Reclamation. An investigation of Baca County has been completed.

A study of the Grand Junction artesian basin has been virtually completed, and a good start has been made on an investigation of Huerfano County.

As a part of the Interior Department's Missouri Basin development program, substantial additional Federal funds have been made available since 1946 for a detailed investigation of the South Platte River Valley between Hardin, Colorado, and Paxton, Nebraska.

Brief investigations were made for the following cities and towns to assist in the solution of municipal ground-water problems: Craig, Dove Creek, Nucla, Salida, Grand Lake, Limon, Arvada, Julesburg, Brush, Calhan, Eads, Las Animas, and Springfield. Reports on ground-water domestic supplies for Julesburg and Brush were published by the Board. Results of the other studies were conveyed to the local officials by letters or memoranda.

The people in many other sections of the State have made requests to the Board for authorization of ground-water studies, and the number and magnitude of such requests have increased far beyond the ability to take care of them within the limited appropriations available for this work. Such requests have been especially numerous from dry-land areas of Eastern Colorado, where potential ground-water irrigation is being zealously sought.

In addition to the specific investigations, a great deal of assistance has been rendered to water users, well drillers, and to State, Federal, and local officials in the solution of their ground-water problems. The volume of this service has increased markedly as the ground-water program has become better known throughout the State.

THE UNITED STATES BUREAU OF RECLAMATION

The Bureau of Reclamation of the United States Department of the Interior was established by Congressional Act in 1902 to administer the Federal Reclamation Act, which provided for the use of funds from public land sales to be used in the construction and maintenance of irrigation works and development of water projects for the reclamation of arid and semi-arid lands. Later legislation increased the activities of the Bureau to include in addition to irrigation, the construction and operation of hydroelectric power plants to assure more complete utilization, through multiple-purpose projects, of the water resources of the arid and semi-arid areas in the 17 States bisected by or west of the 97th meridian. These multi-purpose projects may also serve the purposes of municipal and industrial water supplies, flood control and navigation. Concurrent with legislation providing for the expansion of the Bureau's activities, Congress adopted the policy of making appropriations from the General Treasury to support an enlarged development program.

Demonstrating the Federal interest in and support of the reclamation program, the Congress has made available in recent years the following amounts for reclamation in the 17 western states: In 1947, $117,446,000; in 1948, $142,953,000; in 1949, $266,772,000; and for 1950, $356,514,000.

Denver is the headquarters for one of the principal divisions of the Bureau of Reclamation, namely, the Branch of Design and Construction which prepares plans for all projects in the 17 states. The Chief Engineer in charge of the Branch is L. N. McClellan of Denver. A large staff of engineers is employed in the Branch which is located at the Federal Center, west of Denver.

Region 7 of the Bureau is also located in Denver. The director of this region is Avery A. Batson. This office serves Eastern Colorado, parts of Wyoming and Western Kansas, all of Nebraska and a small part of South Dakota. It is also responsible for constructing such facilities as are necessary for marketing Missouri Basin power as might be available to Iowa and Missouri. The South Platte River District office of Region 7 is located in

Denver. Several construction offices are located at various points, including Estes Park, Loveland and Fort Collins.

Western Colorado is under the jurisdiction of Region 4, with offices in Salt Lake City, Utah, and directed by Ernest O. Larson.

The Rio Grande Basin in Colorado is under the jurisdiction of Region 5, with headquarters in Amarillo, Texas, and directed by H. E. Robbins. Area offices of the Bureau have been established in Colorado at Pueblo, Monte Vista, Grand Junction, and Durango.

CORPS OF ENGINEERS, UNITED STATES ARMY

The Corps of Engineers, United States Army, over a long period of years, has been charged with the responsibility of carrying out Federal activities in river and harbors, navigation, and flood control development. The Corps engages in extensive surveys and studies of proposed flood control projects, including basinwide investigations for this purpose. It is also a construction agency for projects which are authorized by the Congress to accomplish the above-mentioned purposes. Many of its projects at the present time include power facilities. It is also charged with maintaining and operating major improvements for flood control, constructed by it.

From May 1, 1942, until July 1, 1950, a district office of the Corps was maintained at Denver. On the latter date the district office was discontinued and an area office, under the Omaha District Office, was established in Denver. Lt. Col. O. J. Pickard is now in charge of the Denver area office.

The Corps of Engineers in recent years has undertaken important flood control investigations and project construction in Colorado. The principal flood control projects constructed are the John Martin Dam and Reservoir on the Arkansas River, Cherry Creek Flood Control Project on Cherry Creek, a short distance southeast of Denver, and Templeton Gap Flood Control project at Colorado Springs. Minor flood control works also have been constructed in other places, one recently at Creede, Colorado.

Flood control projects authorized for construction by the Corps are the South Platte, consisting of Chatfield Dam and channelization along the South Platte River above and below Denver; an addition to the existing flood control improvements at Pueblo; and flood control works at Morrison and at Trinidad. The South Platte authorized flood control project includes local protective features at Boulder and Erie. The proposed Narrows Reservoir near Fort Morgan and the San Luis Valley project on the upper Rio Grande, authorized for construction by the Bureau of Reclamation, will also serve major flood control purposes.

Investigations are under way by the Corps of Engineers in the interest of flood control in the Arkansas River Basin in Colorado, and a further investigation has been approved for the Dolores River near Dolores. A proposed flood control project at Craig was disapproved by the Colorado Water Conservation Board because of the unwillingness of local interests to participate.

FEDERAL WATER DEVELOPMENT PROJECTS IN COLORADO

In the first 35 years of the Federal reclamation program, from 1902 to 1937, only two Federal projects were constructed in Colorado. These were the Uncompahgre and the Grand Valley projects in Western Colorado, the latter project including the Orchard Mesa Division. Brief descriptions of these projects are contained elsewhere in this chapter. In 1937 Colorado was at the bottom of the list of the 17 Western States in total value of Federal reclamation projects constructed, under construction, or authorized for construction. Since 1937 the State has climbed to third place among the Western States in this respect.

The following tables present the facts with respect to all Federal water development projects in Colorado:

FEDERAL WATER DEVELOPMENT PROJECTS IN COLORADO ON WHICH CONSTRUCTION HAS BEEN COMPLETED

Name of Project	Date of Authorization	Start of Construction	Construction Completed	Cost(1)
Uncompahgre ..... (2)	1903	1904	{1916}	
—Taylor Park Reservoir	1933	1934	{1937}	$ 9,112,400
—Rehabilitation Program	1933	1934	{1940}	
Grand Valley ..... (3) (Including Orchard Mesa Division)	1912	1912	1919	5,008,400
—Emergency Tunnel and Rehabilitation Program	1950	1950	1950	1,500,000
John Martin Dam & Reservoir (4)	1936	1940	1948	15,080,000
Pine River Project..... (5)	1937	1938	1943	3,440,000
Fruitgrowers Dam ..... (6)	1938	1938	1939	200,741
Montezuma ..... (7)	1939	1939	1939	207,272
Stillwater ..... (8)	1939	1939	1940	278,278
Mancos ..... (9)	1940	1941	1949	3,932,000
Cherry Creek Dam.....(10)	1944	1947	1950	15,700,000
Templeton Gap .....(11)	1944	1948	1949	1,031,141
Creede .....(12)	1944	1949	1950	280,900
TOTAL				$55,771,132

(1) This column shows final costs of the particular projects listed, except in a few instances where a project, although essentially completed and in operation, or ready for operation, will require small miscellaneous additional expenditures of money for minor items of construction.

(2) The Uncompahgre Project diverts water from the Gunnison River for irrigation use in Montrose and Delta Counties. The Taylor Park reservoir is located in Gunnison County. The project was constructed by the Bureau of Reclamation. First water under the project was delivered in 1908; the River Diversion Dam was completed in 1912, and the project was transferred to the Uncompahgre Water Users Association for operation and maintenance in 1932.

(3) The Grand Valley Project is located on the Colorado River in Mesa County in Western Colorado. It is a project constructed by the Bureau of Reclamation for irrigation purposes. Of the $1,500,000 listed for the relocated tunnel and rehabilitation program, a sum of $700,000 was set up and used in the tunnel relocation early in 1950 and the remainder is the estimated cost of canal structures proposed for reconstruction.

(4) The John Martin Dam and Reservoir is located on the Arkansas River, a short distance west of Lamar. It is a project constructed by the Corps of Engineers for flood control and conservation purposes.

(5) The Vallecito Reservoir of the Pine River Project is located on the Los Pinos River, a tributary of the San Juan River in the vicinity of Durango in Southwestern Colorado. This project was constructed by the Bureau of Reclamation for irrigation purposes.

(6) Fruitgrowers Dam, an irrigation project constructed by the Bureau of Reclamation, is located in the North Fork Valley near Delta in Western Colorado.

(7) Montezuma Project, for irrigation purposes, is located on Ground Hog Creek, a tributary of the Dolores River near Dolores in Southwestern Colorado. It was built as a Public Works Administration project.

(8) The Stillwater Project, for irrigation purposes, is located on the Upper Yampa River near Yampa in Northwestern Colorado. It was built as a Public Works Administration project.

(9) The Mancos Project in Southwestern Colorado, on the West Mancos River near Mancos, is for irrigation purposes. It was constructed by the Bureau of Reclamation.

(10) Cherry Creek Dam, a flood control and conservation project constructed by the Corps of Engineers, is located approximately six miles southeast of Denver on Cherry Creek, a tributary of the South Platte River.

(11) The Templeton Gap Project for flood control is located near Colorado Springs, on a tributary of Monument Creek, a tributary of the Fountain River, which is a tributary of the Arkansas River. Its primary purpose is to protect the town of Papeton and the City of Colorado Springs from flash floods. It is a project of the Corps of Engineers.

(12) The Creede Project for flood control, a program of the Corps of Engineers, is located at Creede, to control the flood water of Willow Creek.

FEDERAL WATER DEVELOPMENT PROJECTS NOW UNDER CONSTRUCTION IN COLORADO

Project	Date of Authorization	Construction Started	Expected Date of Completion	Total Cost (Estimated)	Expended to June 30, 1950
Colorado-Big Thompson.(1)	1937	1938	1953	$150,503,000	$90,601,861
Paonia .....(2)	1947	1949	....	6,191,000	1,346,094
San Luis Valley.....(3)					
—Conejos Unit	1940	1949	1951	4,200,000	1,529,000
—Rio Grande Unit.....	1940	....	....	36,075,000	.....
Bonny Reservoir .....(4)					
TOTALS.....				$196,969,000	$93,476,955

(1) The Colorado-Big Thompson transmountain diversion project exports water from the Colorado River Basin (West Slope) to the South Platte River Basin (East Slope). The West Slope features are in the vicinity of Grand Lake and Kremmling. The East Slope features are located in the vicinity of Estes Park, Fort Collins, Loveland, and Longmont. The project provides supplemental water for irrigation of 615,000 acres of land in Northeastern Colorado. It is a multiple-purpose project for irrigation, municipal water supplies, and power production. The Bureau of Reclamation is the construction agency.

(2) The Paonia Project is located on the North Fork River, a tributary of the Gunnison River, in Western Colorado. The proposed reservoir will be located in Gunnison County, the canal is principally in Delta County, and the irrigated lands served by the project are in Delta County in the vicinity of Paonia and Hotchkiss. The project, which is for irrigation purposes, is being constructed by the Bureau of Reclamation. The project was originally authorized for construction in 1939. Change in project plans and costs necessitated reauthorization in 1947. Because of the relocation of the storage on the project, inclusion of the Minnesota Creek Division and increased costs, an amended authorization is now being sought in the Congress.

(3) The San Luis Valley project is located on the Upper Rio Grande River in the San Luis Valley. It is a Bureau of Reclamation project and is for irrigation and flood control. Only the Conejos unit is under construction.

(4) The principal project feature of the Bonny Reservoir is located in Colorado on the Arikaree River, a tributary of the Republican River near the Colorado-Kansas state line. The project will serve flood control and irrigation purposes. Only a very minor acreage in Colorado will be benefited by irrigation features of this project. Principal benefits will accrue to lands in Kansas and the principal flood control purposes will be served beyond the Colorado state line. Accordingly, the cost of this project and other data are not included in this summary.

AUTHORIZED FEDERAL PROJECTS IN COLORADO ON WHICH CONSTRUCTION HAS NOT BEEN STARTED

Name of Project	Date of Authorization	Total Cost (Estimated)
Narrows .....(1)	1944	$39,757,000
Morrison .....(2)	1944	539,000
Trinidad .....(3)	1944	2,287,000
Pueblo .....(4)	1950	209,000
South Platte Flood Control.....(5)	1950	26,300,000
TOTAL.....		$69,092,700

(1) The Narrows Reservoir is located on the South Platte River near Fort Morgan in Northeastern Colorado. It is designed for flood control, river regulation, and conservation, and is a Bureau of Reclamation project. It is a part of the Missouri River Basin plan. One of its principal purposes will be to re-regulate water imported from the Colorado River Basin by the Big Thompson Project for use in Colorado. Further investigations on the location, capacity, and plan of operation are being made by the Bureau at the instigation of the Colorado Water Conservation Board and local affected interests.

(2) The Morrison Flood Control Project of the Corps of Engineers, located at the confluence of Bear and Mount Vernon Creeks, in and immediately adjacent to the Town of Morrison, is ten miles southwest of Denver.

(3) The Trinidad Flood Control Project of the Corps of Engineers is located in Trinidad, on the Purgatoire River.

(4) The Pueblo Flood Control Project is located at Pueblo, and will supplement existing flood control facilities in that area. It will be constructed by the Corps of Engineers.

(5) The South Platte Flood Control Project, authorized for construction by the Corps of Engineers, will provide flood control and local protection facilities in the South Platte Basin. The project contemplates a continuous levee system from the proposed Chatfield Dam and Reservoir (eight miles southwest of Denver) to the mouth of St. Vrain Creek (40 miles north of Denver), except through Denver. In addition, selected areas between the mouth of St. Vrain Creek and Fort Morgan, Colorado, will be protected by channel rectification works. The program also contemplates local flood protection measures at Boulder and Erie.

SUMMATION OF AMOUNTS OF FEDERAL MONEY EXPENDED OR AUTHORIZED FOR APPROPRIATION AND EXPENDITURE ON FEDERAL WATER DEVELOPMENT PROJECTS IN COLORADO 1902 TO PRESENT TIME

Expended on completed Federal projects	$55,771,132
Estimated cost of Federal projects now under construction	196,969,000
Estimated costs of Federal projects authorized for construction, on which construction has not been started	69,092,700
Expenditure for project investigations and reports on projects in Colorado by United States Bureau of Reclamation to date. (See details below under heading of "Investigations.")	4,655,052
TOTAL	$326,487,884

FEDERAL EXPENDITURES AND MONEYS APPROPRIATED FOR WATER DEVELOPMENT IN COLORADO 1902 TO PRESENT TIME

Expended for construction, including some investigation and planning—from 1902 to June 30, 1937 (35 years)	$ 12,661,583
Expended for construction—July 1, 1937 to June 30, 1950 (13 years)	136,586,504
Surveys, Investigations and Reports (See details below under heading of "Investigations")	4,655,052
Appropriated by the Congress for construction, for Fiscal Year July 1, 1950 to June 30, 1951	24,478,600
TOTAL	$178,381,739

SURVEYS, INVESTIGATIONS AND REPORTS

The Bureau of Reclamation is charged under the Boulder Canyon Project Act with making general investigations for project development to utilize, conserve, and develop the water resources of the Colorado River. This includes in-basin as well as out-of-basin utilization of water.

A recent compilation of expenditures in Colorado by the Bureau of Reclamation from 1930 to May 1, 1950, shows that for this purpose $1,822,556 has been expended in Western Colorado, including the Colorado portion of general basin studies and of the cost involved in the survey and preparation of report for the Colorado River Storage Project. This figure also includes $135,880 for investigations of the Uncompahgre project rehabilitation. The figure does not include investigation costs of the Mancos, Pine River, Fruitgrowers Dam, and Taylor Park projects. The costs of investigating these projects are included in the construction costs of such projects.

During the same period the Bureau of Reclamation has expended $1,882,496 for investigations and reports on the Colorado-Big Thompson Project, the proposed Gunnison-Arkansas Project, and the proposed Blue-South Platte Project.

This money for general investigations has been made available to the Bureau from the following sources: (1) The Reclamation fund appropriated each year by the Congress for use by the Bureau of Reclamation; (2) the Colorado River Development Fund, created by the Boulder Canyon Project Adjustment Act, which amounts to $500,000 a year, derived from power revenues at Hoover Dam, for use in the States of Colorado, New Mexico, Utah, and Wyoming; and (3) the special fund appropriated by the Congress for expenditure for project investigations in the fiscal year July 1, 1949, to June 30, 1950, in the States of Colorado, New Mexico, Utah, and Wyoming. Approximately $950,000 has been expended by the Bureau for surveys, studies, and reports on projects and investigations in Colorado in addition to those above mentioned. These include such areas as the Upper Rio Grande, the Arkansas, the North Platte, Republican and the South Platte Basins. Thus approximately $4,655,052 has been expended from 1930 to May 1950 by the Bureau for this type of work in Colorado.

Aside from the large Colorado River Storage Project which provides a plan for comprehensive development in the Upper Colorado River Basin, hereinafter explained, the following projects are under investigation in Western Colorado:

Collbran: The investigation of this project has been completed and a report has been submitted by Region 4 of the Bureau, to the seven Colorado River Basin States. No objections to the report were made except by the California-Colorado River Board. The State agency in California neither concurred in nor approved this project. The other states all approved it. It is planned to submit this project to the Congress for authorization at the next session. It is a multiple-use project which will provide water for new land and supplemental irrigation in the Plateau Valley, domestic water supplies for Grand Junction and areas in the vicinity of that city, and hydroelectric energy. The estimated cost of the project is $13,299,000. The City of Grand Junction and vicinity are in critical need of additional domestic water supplies.

Savery-Pot Hook: Two reservoirs, known as the Pot Hook in Colorado and the Savery in Wyoming, have been under investigation for a number of years by the Bureau of Reclamation. These reservoirs will provide storage for irrigation of land (supplemental and new land) in the Little Snake River Valley in Colorado and Wyoming. The Little Snake River crosses the Colorado-Wyoming boundary line a number of times. It is a tributary of the Yampa River. Field investigations have been largely completed and studies of various phases of this proposed development are nearing completion. A planning report is expected to be completed during the year 1951.

Silt: The Silt Project, located near Rifle, has been under investigation for a number of years and a report is nearing completion. The project will serve for the supplemental irrigation of lands near Rifle.

Pine River Project Extension: The proposed Pine River Project Extension is for the purpose of making water available for the irrigation of additional lands which would be supplied with water stored in the completed Vallecito Reservoir east of Durango. The preliminary survey report was recently submitted to the Colorado Water Conservation Board for interim comments of the State. With minor recommendations, the report was approved by the Board. It is planned that this development will be included as a participating project under the Colorado River Storage Project plan. The estimated cost of the project is $4,142,000.

Florida: This project will store and distribute Florida River water for irrigation of land on Florida Mesa. The estimated cost of the project is $6,109,000. The preliminary report was recently submitted by the Bureau of Reclamation to the Colorado Water Conservation Board for interim comments. With certain minor recommendations, the project was approved by the Board. It is recommended by the Colorado Water Conservation Board that it be included as a participating project under the Colorado River Storage plan.

Animas-La Plata: This is a large project near Durango designed to furnish supplemental irrigation supplies and water for new lands in Colorado and New Mexico. The investigations are about 25 per cent complete and a report on the project may be expected by June 30, 1955.

In addition to major project works for diverting Animas River water for use in the La Plata Basin, this project includes two separate units which may be constructed in advance of the main project works. These are the Long Hollow Reservoir in Colorado and the State Line Reservoir near the Colorado-New Mexico line to store water for supplemental irrigation of presently farmed lands. These two units have been under investigation for a number of years. It is planned that reports on these two units will be available so that they may be included as participating projects in the Colorado River Storage plan.

Smith Fork: This project is located in Delta County, on Smith Fork, a tributary to the Gunnison River. It will provide water for new lands and for supplemental irrigation purposes. A report on this project will be completed during 1950. It is recommended by the Colorado Water Conservation Board that this development be a participating project under the Colorado River Storage Project plan.

Fruitgrowers Extension: This project is located in Delta County and is proposed for the irrigation of lands in the Cedaredge area of the North Fork Valley. A report is expected during the year 1951.

San Miguel: This project roughly covers proposals for irrigation of various tracts of land from the San Miguel River. Investigations have been under way for a number of years. Field investigations have been largely completed and studies of various phases of the proposed development are well advanced. A planning report is expected to be completed in 1953.

Dolores: The Dolores Project is proposed for the irrigation of lands in the vicinity of Dove Creek, which are now being farmed largely for the production of pinto beans without the benefit of irrigation. Field investigations have been largely completed and studies of other phases of the proposed development are nearing completion. A planning report is expected in 1951.

Nucla: This proposed project is located in Southwestern Colorado. It would provide for new and supplemental irrigation. Engineering surveys and land classification are well advanced, but considerable work remains to be done on other phases of the investigation. A planning report is expected in 1954.

Paradox: This proposed project is located in Southwestern Colorado. It will provide water for new and supplemental irrigation. Land classification is well advanced, but other work in connection with the investigation has not been initiated. A planning report is expected in 1954.

Saucer Valley: This is a relatively small proposed project located on Disappointment Creek to serve new and presently irrigated lands. The land classification is well advanced and work on other phases of the investigation has been started. A planning report is expected to be completed in 1953.

Gunnison River: This is a reconnaissance investigation of potential developments in the Gunnison River Basin. One of the principal purposes of the investigation is to aid in determining present and potential uses of Colorado River water in Western Colorado. The investigation is nearing completion and a report may be expected in the year 1951.

Cliffs-Divide: The name of this project is misleading. Actually the Cliffs-Divide Project is a reconnaissance investigation of the main stem of the Colorado River and its tributaries above Grand Junction, excluding the Gunnison River Basin. It is one of the important investigations undertaken for the purpose of determining present and proposed utilization in this State of Colorado River water west of the Continental Divide. The Colorado Water Conservation Board has urged that this investigation be expedited. The Bureau has allocated a substantial amount of money to carry on this survey. Land classification and surveys and reconnaissance investigations of proposed canal lines and storage sites are currently being made. A report is expected in the year 1953.

First Stage, Proposed Gunnison-Arkansas Transmountain Diversion Project: The Colorado Water Conservation Board has recommended that this

proposed project be renamed by the Bureau of Reclamation as the "Frying Pan-Arkansas Project." The name "First Stage Gunnison-Arkansas Project" is a misnomer since the diversion of water under the first phase is from the Frying Pan drainage basin and other tributaries of the Roaring Fork River, and such diversion has no relation to any possible future exportation of water from the Gunnison River drainage basin.

The Office of Region 7, Bureau of Reclamation, submitted to the Colorado Water Conservation Board in 1948 its interim report on this project. The Board created a Policy and Review Committee, made up of two representatives from Western Colorado, two from the Arkansas Valley, one from Colorado Springs, one from the State Game and Fish Commission, and two from the Colorado Water Conservation Board. The staff of the Board made extensive review of this report; and the Policy and Review Committee held meetings about every two months over a period of nearly two years. The Committee agreed upon a final report for submission to the Water Board. This report was adopted by the Board, June 16, 1950. The Board reserved action on the question of economic justification of the project until the final report is submitted pursuant to Section 1 of the 1944 Flood Control Act. The comments and recommendations of the Board on the interim report of the Bureau were transmitted to Region 7.

The principal reason for the creation of the Policy and Review Committee was to provide a means for working out the relations between Eastern and Western Colorado in connection with a proposed project for the exportation of water from the natural basin of the Colorado River. The Committee in its work attempted to carry out the policy in Colorado of protecting present and prospective uses of water on the West Slope against such an exportation out of the natural basin. After careful review of all of the questions and problems involved, this group was able to agree upon the nature and extent of project facilities and a plan of operation of the project. The Committee, in its review, took into consideration facilities and plans of operation required to protect fish and wildlife environment affected by the proposed project. This project report has been forwarded by Region 7 to the Washington, D. C., Office of the Bureau of Reclamation for review. It will then be transmitted to the seven affected States of the Colorado River Basin and to Kansas and Oklahoma on the Arkansas River for final official State comments, to be filed within 90 days. Thereafter it is expected that the final report will be forwarded to the Congress by the Bureau where this project will be considered for authorization.

The project will provide urgently needed municipal water supplies for Pueblo, and smaller towns and cities below Pueblo along the Arkansas River; and it is also possible to make available municipal supplies for the City of Colorado Springs. It will also furnish supplemental water for presently irrigated land in the Arkansas River Basin in Colorado. There will be an estimated 104,800 kilowatts of installed hydroelectric capacity on the project.

It is proposed under the project to export approximately 70,000 acre-feet of water from the natural basin of the Colorado River to the Arkansas Basin in Colorado. In addition, native water of the Arkansas River will be regulated to increase power production and make such water more usable for crop production.

Blue-South Platte Project: During 1949 Region 7, Bureau of Reclamation, transmitted to the Colorado Water Conservation Board for review its interim report on the proposed Blue-South Platte Transmountain Diversion Project. In the meantime this report has been under study by the engineering staff of the Board. A special Engineering Advisory Committee previously had been set up to make a study of the water which may be exported by this project. This Committee made a preliminary report. The review by the State has not yet been completed and has been delayed because of questions which still exist as to the amount of water which may be available for exportation by the project. These questions are affected by pending adjudication proceedings in the State and Federal Courts over the appropriative rights on the Blue River. Such proceedings involve water rights for the Green Mountain reservoir unit (near Kremmling) of the Colorado-Big Thompson Project and also for East and West Slope priority claims. The availability of water for exportation by the project may also be affected by current studies being made by the Bureau of Reclamation with respect to present and potential utilization of Colorado River water on the Western Slope.

This proposed project will make water available for municipal uses in the City of Denver and in other municipalities in the South Platte River Basin, and it will provide irrigation water for new lands and supplemental supplies for presently irrigated lands in that basin. There would be a large block of installed hydroelectric capacity. *The extent of the area of new land irrigation and of the power installation, in addition to the municipal water supplies and supplemental irrigation requirements, is dependent upon the final determination of the amount of water supply for this proposed project.* These factors also involve the size of a district which may be set up for contracting with the Government.

San Luis Valley Project: Region 5 of the Bureau of Reclamation has been carrying on for a number of years further studies and investigations of the Rio Grande unit of the San Luis Valley Project. These include land classification and farm unit studies, flood control benefits, present uses of water, both surface and underground supplies, the possibility of the use of water which reaches the so-called sump-drain and other phases of the project. The underground water studies are being carried on by the Bureau in collaboration with the U. S. Geological Survey and the Colorado Water Conservation Board.

As originally authorized, the San Luis Valley Project would provide 40 per cent benefits to flood control and 60 per cent to irrigation. The current studies on flood control benefits are being made, in collaboration with the Corps of Engineers, for the purposes of reappraising such benefits both to the San Luis Valley and to the Middle Rio Grande area in New Mexico. Although the San Luis Valley Project has been authorized, the Rio Grande unit has not gone to construction, awaiting decisions of local interests with respect to the formation of a district to contract with the Government. The Conejos unit of this project is now under construction. (See further description of project elsewhere in this chapter.)

Colorado River Storage Project: The basin-wide investigations in the Colorado River Basin by the Bureau of Reclamation were intensified in 1944, 1945, and 1946. The Department of Interior in July 1947 submitted its interim report on the Colorado River. This report recommended an Upper Colorado River Basin Compact. As elsewhere explained, the Upper Colorado River Basin Compact was negotiated and became effective on April 6, 1949. With this compact the stage was set for the formulation of a comprehensive plan of development for the Upper Colorado River Basin. The problem of conserving and providing for the best means of putting the limited water supplies of the Upper Colorado River Basin to the highest and most efficient use, while at the same time delivering the water, under the Colorado River Compact, for use in the Lower Basin, requires a carefully devised and considered plan in conformity with the provisions of both the Colorado River Compact of 1922 and the Upper Colorado River Basin Compact.

The measure of potential development is shown by the report of the Engineering Advisory Committee of the Compact Commission. According to this report, about 1,385,000 acres of land are being irrigated at the present time in the Upper Basin, and this basin is now consuming, on the average, about 2,000,000 acre-feet of water annually. Projects under construction, or authorized for construction, will increase this amount to about 2,550,000 acre-feet a year. This would leave 4,950,000 acre-feet annually out of the 7,500,000 acre-feet allocated to the Upper Basin for future development.

However, recurrence of unregulated flow conditions in a dry period, such as that from 1931-1940, would permit the Upper Division States to use not more than 2,200,000 acre-feet annually of water in addition to that now used. This amount would be reduced if, in any year, these states were required to assist in meeting deficiencies in water delivery to Mexico as provided by the United States-Mexico Treaty of 1945. Under the Colorado River Compact, they may be called on for such aid.

In order that these Upper States may make full use of the remaining water allocated to them, regulatory reservoirs with an aggregate active capacity of about 23,000,000 acre-feet for long-time holdover purposes are required. This is in addition to the regulatory effect of upstream storage constructed for water-use projects.

Region 4 of the Bureau of Reclamation is now engaged in the preparation of a plan of development of the Upper Colorado River Basin. It is expected

that a preliminary report on the Colorado River Storage Project will be completed during the latter part of 1950.

In the Upper Basin of the Colorado River, under this proposed plan, holdover reservoirs would be constructed with a total capacity of 48,555,000 acre-feet. These would maintain against sediment enroachment an active storage capacity of 23,000,000 acre-feet. Some of the reservoirs would be used jointly for regulation and holdover purposes and for water development in the individual states. The following table gives salient data on the proposed holdover reservoirs included in the plan:

SUMMARIZED DATA ON COLORADO RIVER STORAGE PROJECT

Project Unit	River	Height of Dam Above River (feet)	Total Reservoir Capacity (acre-feet)	Active Storage Capacity (acre-feet)		Power Installation (kilowatts)
				Initially	After 200 Years of Sediment Encroachment	
Cross Mountain	Yampa	295	5,200,000	4,200,000	4,030,000	60,000
Crystal[1]	Gunnison	305	40,000	0	0	48,000
Curecanti	Gunnison	475	2,500,000	2,010,000	1,979,000	54,000
Echo Park	Green	525	6,460,000	5,460,000	5,169,000	200,000
Flaming Gorge	Green	440	3,940,000	2,950,000	2,550,000	72,000
Glen Canyon	Colorado	580	26,000,000	20,000,000	10,455,000	800,000
Gray Canyon	Green	445	2,000,000	1,390,000	698,000	210,000
Navajo	San Juan	335	1,200,000	1,050,000	734,000	30,000
Split Mountain[1]	Green	245	335,000	0	0	100,000
Whitewater	Gunnison	255	880,000	470,000	326,000	48,000
Total.....			48,555,000	37,530,000	25,941,000	1,622,000

[1]Will benefit from upstream storage. Storage at site will be used only for short period power regulation.

The map here reproduced shows the Upper Colorado River Basin and the location of the holdover storage reservoirs:

The reservoirs located on the Gunnison River require further study. The Colorado Water Conservation Board has approved holdover storage on the Gunnison River, but recommended further study with respect to the location and capacity of such storage.

Since the submission of the report and as a result of its consideration by the states, the Navajo Reservoir on the San Juan River has come into the picture as an important initial feature of the plan, largely for the purpose of serving New Mexico in the utilization of its share of Colorado River water.

Although the primary purpose of these reservoirs is to provide long-time holdover storage, these same reservoirs will have an aggregate power installation of 1,780,000 kilowatts.

It is estimated that returns from the power installations will be adequate, under the Federal law as presently applied by the Department of the Interior, to repay costs of the listed reservoirs and all appurtenant works, including the power features. Returns from power will also provide revenues for defraying that part of the costs of a large number of irrigation projects in the Upper Basin which are beyond the ability of the water users to repay. These irrigation projects thus aided are designated by the report as "participating projects."

The project will require many years for completion. It will be built in stages through the selection of initial features and the authorization of others for construction by the Congress from time to time. The states have recommended that the Echo Park, Gunnison River, Navajo and Glen Canyon Reservoirs be included as initial units. This recommendation is conditioned, however, that Glen Canyon construction shall be subject to adjustment of relations between the Upper and Lower Basins on silt control, power benefits, and other considerations.

The states have recommended lists of participating projects which would be included in the initial phase. These are projects on which investigations and reports are completed, or so nearly completed as to afford the necessary factual information for inclusion. Construction of such participating projects will proceed concurrently with the development of the larger holdover reser-

voirs. Additional projects would be authorized by Congress for participation as reports are completed and their economic justification established. Each participating project would be required to meet established economic tests.

The Colorado Water Conservation Board has recommended and requested inclusion for initial authorization the following Colorado projects as "participating projects": The Paonia Project, including the Minnesota Creek division in Delta County; Smith Fork Project, Delta County; Silt Project, located near Rifle; Pine River Extension Project, being a development under the Vallecito River storage on the Pine River near Durango; Florida Project on the Florida River near Durango; two units of the La Plata Project on the La Plata River to serve lands in Colorado and New Mexico; Savery-Pot Hook Project for the irrigation of land in Wyoming and Colorado in the Little Snake River Basin.

As a substantial assistance to Federal reclamation (irrigation) projects utilizing Upper Colorado River Basin waters, the plan establishes an account known as the "Upper Colorado River Account." To this account would be credited all revenues from the sale of electric energy generated by the Colorado River Storage Project in excess of funds required to pay project operation, maintenance, and replacement costs.

It must be realized that the Colorado River storage plan envisions a comprehensive development which may well require decades to build. It meets the requirements incident to a program of ultimate development of the remaining water resources available to the interested states.

BRIEF DESCRIPTION OF PRINCIPAL FEDERAL WATER DEVELOPMENT PROJECTS WHICH HAVE BEEN CONSTRUCTED OR ARE NOW UNDER CONSTRUCTION IN COLORADO

In addition to the information elsewhere contained herein, concerning Federal water development projects in Colorado, the following details on the principal projects which have been constructed or which are now under construction are included, namely:

Uncompahgre Project: This was the first project authorized for construction by the Bureau of Reclamation in Colorado and it was one of the first projects undertaken by the Bureau in the West after the passage of the Reclamation Act of 1902. Congress authorized the project in 1903.

The principal physical features of the project consist of the Taylor Park reservoir, located on the Taylor River where that stream emerges from Taylor Park in Gunnison County, the Gunnison tunnel and the distribution works in the Uncompahgre Valley. Taylor Park Reservoir, located 32 miles northeast of the City of Gunnison, was completed in 1937, more than 25 years after the other principal features of the project were placed in operation. The reservoir provides storage capacity of 106,230 acre-feet of water. It has a surface area of 2,060 acres. The drainage area above the reservoir has an estimated average annual runoff of 125,000 acre-feet of water a year.

The Gunnison tunnel is 5.8 miles long and its cross section is in the shape of a horseshoe, being 10 feet wide at the base and 12.4 feet high at the center of the arch. It carries water diverted from the Gunnison River at a point located in the Black Canyon to the Uncompahgre Valley. This tunnel was considered a notable engineering accomplishment of the time. It was formally opened by President Taft at dedication ceremonies on September 23, 1909.

The distribution system consists of canals and appurtenant works which carry Gunnison River water, as well as water diverted from the Uncompahgre River, to the irrigated area along the Uncompahgre Valley in Montrose and Delta Counties. This area extends from a point about eight miles south of Montrose to Delta, 22 miles north of Montrose.

In 1945 the Bureau initiated a soils and land classification study on this project. When the project was authorized in 1903 it was contemplated that 140,000 acres of land could be put under irrigation. Based on the land reclassification study, it was found that the project actually comprised only 70,820 acres of irrigable land. Following this land reclassification, the Government and the Uncompahgre Water Users Association in 1948 entered into a revised repayment contract.

Grand Valley Project: The Grand Valley Project, including the Orchard Mesa Division, is located in the Grand Valley, on the main Colorado River

near Grand Junction and Palisade. The Grand Valley project was the second one constructed by the Bureau of Reclamation in Colorado. It was started in 1912. The High Line Canal was completed in 1915 and the Price-Stub pumping plant in 1919. Work on the Orchard Mesa power canal and siphon was completed in May 1923. In the spring of 1926 final work on the reconstruction of the Orchard Mesa distribution canals was completed. The Grand Valley Power plant was put in operation during 1933.

The source of water supplied for these projects is the Colorado River. Water for the Grand Valley Project is diverted by a dam eight miles northeast of Palisade into the main canal which is 55 miles in length.

The Grand Valley Project contains 40,556 acres which may be supplied with water through project facilities. In addition there are 10,113 acres possible for ultimate development under the project. The irrigable area under the Orchard Mesa Division is 10,027 acres. In addition, the project supplies water to 8,400 acres under water carriage contracts.

The main canal of the Grand Valley project, after it leaves the diversion point on the river, passes through three tunnels parallel to the Colorado River. In recent years one tunnel was subject to pressure caused by the moving action of the hill through which it passes. This resulted in gradual displacement of the tunnel lining. In March 1950, this tunnel completely failed. Prior to this the Bureau had made explorations and surveys for the purpose of relocating the tunnel. Such relocation involved routing a considerable portion of it through solid rock.

This tunnel failure cast a gloomy outlook for this important irrigated area which included a considerable portion of the valuable peach acreage near Palisade.

Director Larson of Region 4, Bureau of Reclamation, and his associates attacked the problem with dispatch. An outstanding construction record was made. Plans and specifications for the relocated tunnel were completed on March 13, 1950; a contract for construction was awarded on March 16, 1950; and construction was completed and water back in the canal on May 4, 1950. Allocations were made by the Bureau from the emergency funds in the amount of $700,000 for this tunnel relocation. An additional amount of $800,000 has been requested for further rehabilitation work on the Grand Valley Project during the fiscal year 1951.

John Martin Dam and Reservoir: This project, the first major flood control works constructed by the Corps of Engineers in Colorado, was authorized by the Congress in 1936, as the Caddoa Reservoir Project. The name was changed by an Act of Congress to John Martin Reservoir Project in 1940, following the death of Congressman John A. Martin of Pueblo, who had been active for many years in urging Congressional approval of this development. The project is located on the Arkansas River in Bent County, 18 miles west of Lamar, and 50 miles above the Colorado-Kansas state line. It is 295 miles below the source of the Arkansas River and 1,155 miles above its mouth.

The project serves flood control and water conservation (irrigation) purposes. It is a unit of a comprehensive plan for flood control in the Arkansas River Basin.

The reservoir at maximum pool level will be 14.2 miles in length, with an average width of 1.9 miles, and will cover an area of 27½ square miles. It has a maximum storage capacity of approximately 683,000 acre-feet. About 281,000 acre-feet of this capacity is allocated to flood control storage and the remaining capacity of approximately 402,000 acre-feet is available for conservation storage.

The dam is a concrete and earth-filled structure approximately 130 feet high with an overflow gated spillway 1,174 feet long.

The project was substantially completed and placed in operation in 1948. The final cost of the project will be approximately $15,080,000.

After the Arkansas River Compact, between the States of Colorado and Kansas, became effective in May, 1949, the use of the water stored in John Martin Reservoir for irrigation purposes in the two states became subject to the provisions of that document. The compact, supplemented by rules and regulations, adopted by the Arkansas River Compact Administration, defined the respective responsibilities of the Corps of Engineers, the Administration, and officials of the States of Colorado and Kansas charged with the adminis-

tration of water rights. The plan of operation of the conservation capacity of the project, thus effectuated, includes provision for making the conservation storage benefits available to water users upstream as well as below the reservoir. Broadly this is accomplished by a suspension of the operation of priority rights in Colorado below the reservoir against upstream priority rights during such time as water is available in the reservoir for release to serve irrigation demands downstream in Colorado and Kansas. The benefits to irrigation afforded by this project during the brief period of experience under its operation have far exceeded the most optimistic predictions.

Pine River Project: This project is located in Archuleta and La Plata Counties in the Los Pinos River Valley, a tributary of the San Juan River. The project was completed in 1943 at a cost of $3,440,000. It provides water for both supplemental and new land irrigation.

The need for the project arose largely because of a superior right in the water of the Los Pinos River established in the courts over a period of many years, for the irrigation of Indian lands in the area. The conditions which brought about this situation date back to about 1877, when small irrigation ditches were first constructed by white people along the Pine River for the Indian agencies and for a few small farm tracts. Water filings were made with the State engineer in 1895, covering estimated water requirements for approximately 18,000 acres belonging to the Indians. These claims were contested by the white people, many of whom had made earlier filings and an adjudication suit was filed in 1901. On October 25, 1930, the Federal court granted a priority to the Indians, as of July 25, 1868, of 213 second feet of water from the Los Pinos for irrigating 16,966 acres. This primary right of the Indians to the waters of the Los Pinos caused an acute shortage of water for lands of the white farmers in the region. In many years the natural flow of the river during growing seasons did not even meet the irrigation requirements of the Indians.

The possibilities for storing flood and snow-melt water for irrigation led to the Pine River investigation, which was conducted by the Bureau of Reclamation in 1924 and 1925. As a result of a report on these surveys, the Secretary of the Interior appointed a committee to conduct irrigation investigations whose report "Irrigation on Indian Reservations," was submitted to the Secretary in June 1928. Because of the importance of Southern Ute Indian lands in irrigation investigations, the Office of Indian Affairs handled investigations until 1934, when the Pine River Project was turned over to the Bureau of Reclamation for planning and construction. Under the Interior Department Appropriation Act of 1937, the project was authorized and a finding of feasibility was approved by the President on June 17, 1937.

The Office of Indian Affairs entered into a contract with the United States on December 6, 1939, to pay one-sixth of the reimbursable construction costs of the Vallecito Dam and Reservoir. The Pine River Irrigation District, composed of the white water users, made a similar contract on April 15, 1940, to pay five-sixths of such costs.

The principal physical feature of the project is the Vallecito Dam and Reservoir, located 14 miles north of Bayfield. The reservoir has a capacity of 126,200 acre-feet and is expected ultimately to provide irrigation storage for an estimated 69,080 acres of land in Southwestern Colorado and Northwestern New Mexico, including a supplemental supply for 17,000 acres of Indian lands.

The Pine River Project Extension will provide the necessary canals and laterals to serve new lands with water from the Vallecito Reservoir storage in addition to the lands which are presently receiving supplemental water. It is important to construct this addition in order to realize as soon as possible the full benefits for irrigation from this available storage.

Fruitgrowers Dam Project: This project is located on Alfalfa Run, a tributary to the Gunnison River, to provide storage for the irrigation of a highly developed agricultural area near Austin in Delta County. It replaces a dam built by the settlers in 1898. This old dam failed in 1937. Since storage of water at this point was needed for late summer water supplies on fruit lands and the lack of storage would result in extensive financial loss to the farmers, the Bureau of Reclamation immediately initiated surveys for a new dam and a Federal project of reconstruction was authorized in 1938. The project was completed and water made available for the irrigation season of 1939. Operation and maintenance of the dam was turned over to the Orchard City Irrigation District in March 1940.

The Fruitgrowers Reservoir has a capacity of 4,600 acre-feet, with a surface area of 463 acres. The irrigated area under the project is approximately 2,050 acres.

Mancos Project: This project is located near Mancos in Southwestern Colorado. It provides storage for rehabilitation of an agricultural area inadequately irrigated and for supplementing existing domestic water supply in Mesa Verde National Park. Approximately 12,900 acres of farm land are benefited by the project. Irrigation started in this area in 1876, but by 1893 when the adjudication of water was made, it was found that late summer demands for irrigation water far exceeded the average natural flow of West Mancos River.

The Bureau of Reclamation commenced investigation of the project in 1936 and its report recommended storage at an off-channel site in Jackson Gulch. The project was authorized by the President, October 24, 1940, under the Water Conservation and Utilization program, and construction began on July 24, 1941. World War II delayed construction progress and the project was not completed until 1949.

The Jackson Gulch Reservoir provides an active storage capacity of 9,770 acre-feet. A canal, 3.2 miles in length, conveys the water of the West Mancos River to the reservoir. Stored water is returned as required for irrigation to the same stream by a canal 2.56 miles in length. This point of return to the river supplies water for all existing irrigation distribution systems.

The project is designed to provide for domestic water supply of 120 acre-feet of stored water for the Mesa Verde National Park. The present water supply for the park is of poor quality and inadequate. The final cost of the project is $3,849,233.

Cherry Creek Dam and Reservoir: This is a project constructed by the Corps of Engineers. The project is located six miles southeast of the City of Denver on Cherry Creek, a tributary of the South Platte River. The dam was authorized in 1941, House Document 426, 76th Congress, 1st Session, and is included as part of the general comprehensive plan for the Missouri River Basin in the Flood Control Act of 1944.

The primary purpose of Cherry Creek Dam and Reservoir is to protect the City of Denver from the flash floods that occur on Cherry Creek. There are approximately 5,000 dwellings, five railroads and many business establishments within the Cherry Creek flood plain subject to damages from floods on Cherry Creek. Provisions have been made in the design for modification of the project for ultimate storage of transmountain irrigation water in the reservoir.

Construction of Cherry Creek Dam was initiated in 1946, and it was essentially completed in June 1950. The dam is an earth-fill structure with a maximum height of 140 feet above stream bed, and a total length of 14,300 feet. The project includes gated, concrete outlet works, and an uncontrolled side channel spillway canal which discharges into adjacent Tollgate Creek, thus by-passing the City of Denver. The reservoir has a storage capacity of 95,000 acre-feet, of which 85,000 acre-feet is reserved for flood control, and 10,000 acre-feet for silt control. During flood periods the excess flood waters will be temporarily stored in the reservoir and be released at rates which will give maximum flood control benefits to the downstream areas.

A permanent pool will be established in the reservoir by modification of the spillway and outlet works when irrigation storage is provided in the ultimate development. It is proposed that water diverted from the Western Slope by the proposed Blue River-South Platte Project of the Bureau of Reclamation be stored in the Cherry Creek Reservoir and then be released as supplemental water supply to irrigable land north and east of Denver.

The estimated cost of Cherry Creek Dam under the initial development for flood control is $15,700,000. An equitable portion of this cost will be allocated to irrigation interests for repayment under existing irrigation laws in the event of the use finally of part of the storage capacity for beneficial consumptive-use purpose.

No flood control benefits have accrued to date but it is estimated that without these protective works and in the event of the "project design flood", the damages to Denver and vicinity would be $70,000,000.

Colorado-Big Thompson Project: This is Colorado's largest Federal reclamation project. Measured by the size of physical facilities, cost and benefits which will be derived from the project, it overshadows all other Federal water

development ever undertaken by actual construction in the State. In fact, the Colorado-Big Thompson ranks with the Hoover Dam, the Grand Coulee and Central Valley of California projects, as one of the largest projects undertaken by the Bureau of Reclamation. None is more spectacular in design and plan of operation. Its works for interception of 310,000 acre-feet of water a year from the Pacific Slope, its mammoth pumps which lift a major portion of such water to a maximum height of 186 feet, its thirteen-mile tunnel piercing the Continental Divide, its East Slope aqueduct largely through additional tunnels, making in all about thirty miles of tunnels on the project, which drops the water nearly 3,000 feet through five power plants to the base of the foothills, and its extensive reservoir storage along the Front Range to regulate the water for the irrigation of more than 700,000 acres of land—all present a public works undertaking that challenges the imagination and which calls forth the best, modern-day engineering skill.

The concept for such a transmountain diversion project to provide water for supplemental irrigation in the highly developed agricultural area of Northeastern Colorado was presented in a preliminary engineer report prepared and completed in December 1933 by Royce J. Tipton, now Consulting Engineer of the Colorado Water Conservation Board. In August 1935 the Bureau of Reclamation was allotted $150,000 of Public Works Administration funds for further surveys and investigations. After more than two years of extensive study, a plan was developed which contained the essential features of the present-day Colorado-Big Thompson Project.

Such a proposal, however, met opposition from West Slope interests in Colorado. They feared exportation of water from the natural basin of the Colorado River in Colorado would jeopardize present and future development in that part of the State.

A long series of conferences, initiated and arranged by the Colorado State Planning Commission, between East Slope and West Slope interests, was held. Finally, in 1937 an agreement between the representatives of the two Slopes was reached. This agreement was written into what is known as "Senate Document 80." This document provided the plan of operation, including the installation of project features, which would protect the present and prospective uses of Colorado River water in Western Colorado.

The project was authorized in 1937 by two separate actions, one by the Congress and the other by the President. This authorization is shown by the Interior Department Appropriation Act of August 9, 1937 (50 Stat. 595) and by a finding of feasibility approved by the President on December 21, 1937, in keeping with the plan contained in Senate Document 80, 75th Congress, first session. The report on the project, made by the Secretary of the Interior, is dated April 24, 1937.

An initial appropriation was secured and construction commenced on the Green Mountain Dam near Kremmling, on November 30, 1938. The dam is located on the Blue River, a tributary of the Colorado River. Storage created by that dam provides replacement water to protect Colorado River Basin uses against depletion resulting from diversion of water to the East Slope. This feature of the project also includes a power plant with 21,600 kw of hydroelectric power installation. The reservoir has a capacity of 154,600 acre-feet. This feature was completed in 1943 and the first power transmitted from the power plant at the dam on May 18, 1943.

Construction of the Alva B. Adams Tunnel, the key feature of this water diversion project, was commenced in June, 1940. This tunnel was completed and the first water carried through it on June 23, 1947. The full capacity of the tunnel cannot be used until all of the major features of the project have been completed.

The present estimated cost of the project is $150,503,000. There has been appropriated to date over $96,000,000; and adding the amount contained in the appropriation bill for the fiscal year ending June 30, 1951, there will have been made available slightly over $116,772,600 for this undertaking. It is estimated that if anticipated appropriations are made available by the Congress the project will be substantially completed in 1953. Work on the project, which has now been in progress for over 12 years, was greatly delayed by World war II.

Detailed planning studies have been continued while construction was under way. These studies have resulted, particularly for power purposes, in beneficial modifications of the original project plans. Some reservoir capac-

ities have been changed; other reservoirs were added to, or dropped from, the plan; part of the East Slope water routing has been changed; and further power installations, including transmission lines, added.

This development is a multiple-purpose project. It is designed to provide 310,000 acre-feet of water each year for the supplemental irrigation in excess of 700,000 acres of highly developed agricultural land in Northeastern Colorado; it will produce an estimated 557,000,000 kwh of annual, salable firm energy, an estimated 63,000,000 kwh of annual salable non-firm energy, and an additional 58,000,000 kwh of firm energy to meet project operation requirements; and it will furnish municipal water supplies for a number of towns and cities in the area.

The water interception works in Western Colorado are located in the Grand Lake area and the East Slope features, both for irrigation and power, are located in the vicinity of Estes Park, Loveland, Longmont, Fort Collins, and Greeley. The lands which will be benefited by irrigation water supplies extend along the South Platte River and its tributaries from the foothills to the Colorado-Nebraska state boundary line.

The Northern Colorado Water Conservancy District, comprising approximately 700,000 acres of land, was created, under the Conservancy District Act of Colorado of 1937, to contract with the United States for the repayment of that portion of project cost allocated to irrigation. A contract was entered into on July 5, 1938, between the District and the United States for the repayment of $25,000,000. The balance of the project cost, under the existing contract, is repayable from power revenues. By repayment arrangement, and, in accordance with sub-contracts between the District and the water users, the farmer will pay $1.50 an acre-foot for water, and it is estimated that the equivalent of 50 cents an acre-foot will be repaid from general taxation levied and assessed against all property in the District.

Recent plans under discussion contemplate the providing of additional domestic water supplies needed for Boulder. Such arrangements must be consummated between the City of Boulder and the Northern Colorado Water Conservancy District.

Except for the power plant installed at Green Mountain Reservoir, all other plants are located between the east portal of the Alva B. Adams Tunnel and the valley floor. These East Slope plants, together with proposed installed capacity, are as follows: Marys Lake, 8,100 kw; Estes, 45,000 kw; Pole Hill, 33,250 kw; Flatiron, 63,000 kw; Big Thompson, 6,700 kw.

Adding the 21,600 kw for Green Mountain Power Plant, the entire project has an installed capacity of 177,650 kw.

The presently estimated cost of transmission lines and sub-stations of the project is $19,105,290. Of this amount, lines and sub-stations costing $4,754,363 are essentially complete and other lines estimated to cost $4,023,000 are under construction. An interesting feature of power transmission is the cable which carries power through the Alva B. Adams Tunnel, interconnecting power on the two Slopes, instead of across the Continental Divide as originally planned. It was found that this method was less expensive and involved a smaller initial cost than transmission across the mountains.

The principal transmission lines serve areas in Eastern Colorado and will interconnect with transmission lines from Bureau of Reclamation power plants in Wyoming. A transmission line from Kremmling, near the Green Mountain Reservoir and power plant, to Oak Creek, has been authorized and is under construction; and a transmission line which will be energized with power from Green Mountain power plant has been authorized for construction between Salida, and Gunnison. It is expected that construction of the Oak Creek line will be completed by March 1, 1951, and the Gunnison line by January 1, 1952.

Features of the Colorado-Big Thompson Project on which construction is essentially complete are: Green Mountain Dam and Reservoir, costing $6,997,124; Alva B. Adams Tunnel, $12,505,962; Shadow Mountain Dam, and Lake, $1,149,764; Granby Dam and Reservoir, $11,087,832; Horsetooth Dam and Reservoir (near Fort Collins), $12,238,263; Green Mountain Power Plant and Switchyard, $1,440,948; Estes Park Lake and Olympus Dam, $2,249,750; Prospect Mountain Tunnel and Surge Tank, $1,534,358; Prospect Mountain Conduit, $951,421; Marys Lake Reservoir Enlargement, $119,842; Rams Horn Tunnel, $865,985; Aspen Creek Siphon, $1,279,299; Granby Pumping Plant and Canal, $9,137,000; Marys Lake Power Plant and Switchyard, $2,520,429; Estes Power Plant, $6,216,926; and transmission lines and sub-stations, $4,754,363.

In 1947 when the Alva B. Adams Tunnel was completed, a separate contract was made between the District and certain water users in the vicinity of Loveland, for the diversion of relatively small amounts of water, pending the completion of the entire project. Under this arrangement the water users constructed at their own expense a temporary pipeline which carries water from the east portal of the Alva B. Adams Tunnel into the Thompson River above Estes Park.

With the completion of the construction of certain major features of the Colorado-Big Thompson Project, the matter of the utilization and protection of incidental recreational features came to the forefront. Such features as Green Mountain Reservoir, Shadow Mountain Lake, and Estes Park Lake provided recreational opportunities in areas adjacent to the Rocky Mountain National Park which are visited by hundreds of thousands of people each year.

Plans for recreational facilities were devised by the Bureau, in collaboration with the National Park Service, and submitted to the Colorado Water Conservation Board and the Colorado Game and Fish Commission. Later the State Water Board and the State Game and Fish Commission agreed upon the form of a bill for authorizing, and providing for the manner of administering, recreational phases of the project. This bill was passed by the Congress, but vetoed by the President. The veto message gave as the principal reason for Presidential disapproval that the legislation was confined to a single project and that any enactment of the Congress on the subject should apply to the entire reclamation program.

Paonia Project: This project, one feature of which is now under construction, is located in the lower North Fork River watershed. The North Fork River enters the Gunnison River above Delta. A large part of the area is devoted to highly developed agriculture, including varieties of fruit such as peaches, apples, and sweet cherries.

By 1900 rights to the late summer natural flow of the streams tributary to the North Fork River had become fully appropriated and farmers with junior water rights were seeking ways to obtain supplemental water. Preliminary surveys of reservoir sites indicated that storage on the North Fork watershed would be relatively expensive and too difficult for local financing.

In the drouth year of 1934, the State Engineer of Colorado investigated a number of reservoir sites in this area. As a result of these investigations and the activities of local water users, the Bureau of Reclamation in 1936 commenced investigation of storage possibilities in the North Fork drainage basin. A preliminary report by the Bureau in August 1938 suggested the development of a reservoir of the Horse Ranch site on Anthracite Creek to serve lands under the existing Fire Mountain Canal. Anthracite Creek is an upper tributary of the North Fork River. On the strength of this report, the Paonia Project was first authorized in 1939.

Subsequent surveys warranted the issuance of a revised report in 1940 and again in 1946. The project plan under these later reports was revised to include storage at the Spring Creek Reservoir site in lieu of the Horse Ranch and Beaver Creek sites, to include a total of 14,750 acres of land for irrigation, to provide 4,000 acre-feet of surplus reservoir capacity, and to permit enlargement and improvement of the Overland Canal, as well as the Fire Mountain Canal.

The various authorizations of the project are: (a) Under the Reclamation Law by the Secretary of Interior on March 18, 1939, which followed Presidential approval on March 16, 1939; and (b) finding of feasibility by the Commissioner of the Bureau on May 9, 1947, followed by an Act of the Congress on June 25, 1947. (61 Stat. 181, Public Law 117, 80th Cong., 1st Sess.)

Appropriations for the project were made in the Interior Appropriations Act of 1940 for $300,000, in the Interior Appropriations Act of 1942 for an additional sum of $600,000. The sum of $1,057,000 is included in the appropriation for Federal reclamation projects for fiscal 1951.

Construction work on the rehabilitation and extension of the Fire Mountain Canal, a feature of the project, was commenced in 1948 and will be completed early in 1951.

On June 5, 1948, a public election of electors of the North Fork Conservancy District and of stockholders for the Fire Mountain Canal approved a contract between the United States and the water users for repayment of the cost of construction in 68 years as authorized by the above-mentioned Act of Congress.

However, even after 12 years of surveys, two seperate authorizations for construction, and after construction was started on the Fire Mountain Canal, it was found necessary for further studies and investigations to be made. This was necessitated by what was determined to be unsatisfactory foundation conditions at the Spring Creek site, which was selected in the 1946 report. In recent months a revised report, made by Region 4 of the Bureau, relocates reservoir storage for the second time, includes the Minnesota Creek Division for irrigation under the project, and increases the costs. It has been held by the Bureau of Reclamation that these recent changes in plans require an amended authorization; and in the present Congress a bill has been introduced for this purpose. The principal features of the project as shown by the latest report are: (1) Spring Creek Reservoir, located on the Muddy Creek and with a total capacity of 18,000 acre-feet. (Eleven thousand acre-feet will be active and used for irrigation and 7,000 acre-feet will serve sediment retention and dead storage); (2) the enlargement and rehabilitation of the Fire Mountain Canal with a capacity of 200 second feet; (3) siphon and pump lift to convey water from the Fire Mountain Canal for the irrigation of the added Minnesota Creek Division of the project; and (4) improvement and enlargement of the Laroux Creek Reservoir system.

The project will provide for the supplemental irrigation of 14,830 acres of irrigated land and full irrigation of 2,210 acres of new land, all in the vicinity of Paonia and Hotchkiss, Delta County. The reservoir is located in Gunnison County. There are 2,010 acres of irrigable land under the added Minnesota Creek diversion. These lands are now partially irrigated under existing canals but are without a dependable water supply.

The present estimated cost of the project is $6,191,000. Water users under the project will be unable to repay that part of the cost allocated to irrigation; and it is planned that a substantial portion of the project cost will be returned from excess power revenues under the Colorado River Storeage Project.

San Luis Valley Project: This project is located in the San Luis Valley, in the Upper Rio Grande Basin. In 1939, under the direction of Royce J. Tipton, the engineering staff of the Colorado Water Conservation Board prepared a report for a project in the San Luis Valley to accomplish storage and regulation of water for supplemental irrigation purposes and to provide flood control. Later this report was reviewed by both the Corps of Engineers and the Bureau of Reclamation, further investigations made, and reports thereon made by both of these Federal agencies. Previously the National Resources Planning Board, under a program financed by the interested states in the Rio Grande Basin and the Federal Government, had made a basin report known as the Rio Grande Joint Investigation.

This project was authorized for construction on April 10, 1940, by the Secretary of the Interior on the finding of feasibility. The President, on March 30, 1940, approved the project. The finding of feasibility, together with related documents, was transmitted to the Congress and printed as House Document 693 (76th Cong., 3d Sess.). The Interior Department Appropriation Act, 1941 (Act June 18, 1940, 54 Stat. 406, 438, Public Law 640, 76th Cong., 3d Sess.), contained an appropriation of $150,000 for future investigations, exploratory and preparatory work, and commencement of construction. The Appropriation Act further provided that commencement of construction of the Closed Basin drain feature should be contingent on a conclusive finding of justification for the drain on the basis of cost and the quantity and quality of water to be secured therefrom; and that any works to be constructed must not interfere with or abrogate any of the terms of the Rio Grande Compact.

Early in 1949, at the instigation of water users under the Conejos Division of the project, revision of the plans for the Conejos was recommended under a study made by Royce J. Tipton, Consulting Engineer of the Colorado Water Conservation Board. These recommendations were considered and further studies made by the Bureau of Reclamation with the result that on March 3, 1949, the Commissioner of the Bureau of Reclamation submitted to the Secretary of the Interior supplemental findings with respect to the Conejos Division. These supplemental findings called attention to the fact that House Document 693 had recommended that: "Prior to construction of the Conejos unit, further investigations should be made to ascertain the desirability of substituting a single main-stream reservoir on its lower reaches for the two reservoirs as better regulations will result." These findings further pointed out that the

necessary additional investigations had been made and on September 29, 1947, the conclusions drawn from those investigations were reported to the Secretary of Interior. On October 3, 1947, the Commissioner stated, the Secretary of Interior had approved the construction of the Platoro Reservoir, one of two reservoirs planned as the first stage of the development in the San Luis Valley Project. These findings of the Commissioner recommended with respect to the total cost of $4,200,000 of the Conejos unit: (a) That the part of the estimated cost of the Platoro Reservoir which can properly be allocated to irrigation and repaid by the water users is $2,520,000; and (b) that the part of the estimated cost of construction of such reservoir which can properly be allocated to flood control is $1,680,000. Later the Secretary, under date of March 7, 1949, approved these recommendations.

That part of the costs allocated to irrigation will be repaid by the irrigators in 40 years, plus a five-year development period. A repayment contract was entered into between the United States and the Conejos Water Conservancy District on March 31, 1949.

The revised plan for the Conejos Project provides for 60,000 acre-feet storage of water in the Platoro Reservoir on the headwater of the Conejos River. The stored water will benefit approximately 80,000 acres of land through regulation of existing water supplies. The stored water is delivered at the head of the existing distribution system, which serves the presently irrigated lands.

Construction of the Platoro Reservoir began in the spring of 1949 and it is expected will be ready to store water in 1951.

Total appropriations which have been made to date for investigation and construction of the San Luis Valley Project aggregate $2.992.410. The appropriation bill for fiscal 1951 includes an additional $1,839,000 for the project. A deficiency appropriation of $650,410 was made by the present Congress and is included in the above total appropriation.

The original authorization of the San Luis Valley project, made in 1940, estimated its total cost at $17,465,000 and specified that the project would serve flood control purposes and provide supplemental water for 400,000 acres of land already under irrigation. As shown by the tabulations contained in this chapter, the present estimated cost of the Rio Grande unit of the project is $36,075,000.

Construction of the Rio Grande unit has been delayed because of questions arising respecting formation of a district in the area to be served by this unit of the project. The principal proposed feature of this unit is the large Wagon Wheel Gap Dam and Reservoir. It also includes the proposed Weminuche feature which would import an estimated 21,000 acre-feet of water a year from the San Juan Basin. As elsewhere explained in this chapter, investigations of the Rio Grande unit are being continued by the Bureau of Reclamation.

RIVER BASIN DEVELOPMENT

No review of the Colorado water development program, however brief, would be complete without a mention of some of the broad aspects of and problems incident to, pending and proposed programs for comprehensive, basin-wide development in major river basins which lie partially in this State. In this article, reference has been made to some phases of such development, such as interstate litigation, water compacts, and administrative commissions. Also the program for the utilization of the Upper Colorado River Basin is more fully covered. But there are other activities of this nature which concern this State.

Colorado River Basin: Ever since the Colorado Water Conservation Board was created, there have been constantly recurring problems requiring the attention of the staff of that Board with respect to the Colorado River. Brief mention may be made to some of the activities, in which this State participated, on this river during the past 13 years.

The State was very active in the work of the Committees of Fourteen and Sixteen which were first organized to deal with proposed legislation which resulted in the Boulder Canyon Project Adjustment Act, approved in 1940. Under this Act, Colorado, along with other Upper Basin States, has been benefited by the payment of $500,000 a year from power revenues at Hoover

Dam. These revenues have been used to aid in the investigation for water development in the Upper Colorado River Basin.

The State actively participated, largely through the Basin Committee of Sixteen, in the numerous discussions between the United States Department of State and the American Section of the International Boundary and Water Commission and the Colorado River Basin States which led to the United States-Mexican water treaty in 1945. This treaty allocated a specified amount of Colorado River water for use in Mexico. Later the State was a member of the Committee of Six made up of representatives of Arizona, Colorado, New Mexico, Utah, Wyoming and Texas organized to support and urge ratification of the treaty by the United States Senate. The apportionment of Colorado River water to Mexico was a necessary step before the apportionment of water among the Upper Colorado River Basin States could be undertaken as a basis for a plan of future development.

Colorado had an indirect but important interest in the negotiations among the Colorado River Basin States which led to the making of a contract between the Secretary of the Interior and the State of Arizona for the use of water stored in Lake Mead. As a result of that contract Arizona, after more than 20 years of delay, in 1944 ratified the Colorado River Compact of 1922.

The State is now a member of the Colorado River Basin States Committee, made up of representatives appointed by the Governors of these states. California withdrew from the old Colorado River Committees of Fourteen and Sixteen and to date has not seen fit to participate as a member in the Colorado River Basin States Committee; and California's position in this matter has been followed by the State of Nevada.

At the present time, and in more recent years, Colorado is vitally concerned with continuing efforts made by the State of California to initiate litigation in the Supreme Court of the United States for the determination of the respective rights of Colorado River Basin States in the waters of the Colorado River.

In the judgment of Colorado, the California position in this matter would interpret the Colorado River Compact of 1922 contrary to the intent and purpose of that document resulting in a substantial decrease in the amount of Colorado River water which this State could utilize: and there appears to be a real basis for the fear that California's real objective is in effect to abrogate, through action before the United States Supreme Court, the provisions of the seven-state compact. This in turn would have the effect of destroying the basis of the recently negotiated Upper Colorado River Basin Compact.

This whole Colorado River situation requires constant attention on the part of this State. A considerable part of the time of the staff of the Colorado Water Conservation Board has been devoted to this task.

Missouri Basin: Colorado is a member of the Missouri Basin States Committee and has actively participated in the program of that group since it was created in 1943. Allied with the Missouri Basin States Committee is the Missouri Basin Inter-Agency Committee, made up of representatives of interested Federal agencies and the affected States, which has undertaken month-by-month planning and general supervision of the Missouri Basin comprehensive program of development authorized by the Flood Control Act of December 22, 1944 (Public Law 534, 78th Cong., 2d Sess.). Portions of both the North and South Platte River Basins and parts of the Kansas River Basin, all of which are tributary to the Missouri River, lie in the State of Colorado; and it is necessary that this State maintain such relations with the other Missouri Basin States and the above-mentioned Inter-Agency Committee as will insure the protection of its interest in the water development of the Missouri Basin. As an example, recently the Missouri Basin Inter-Agency Committee has considered questions which arise under the proposed Glendo Dam on the North Platte near the Wyoming-Nebraska state boundary line. The State Water Board is actively participating in this matter because storage at the Glendo site and a plan of operation of such storage, if not properly set up, could adversely affect Colorado's rights under the decree of the Supreme Court on the North Platte River.

Arkansas Basin: The omnibus Rivers and Harbors and Flood Control Authorization Act of 1950 contained a section which directed the Corps of Engineers to undertake an investigation for a comprehensive plan of development in the Arkansas-Red and White River basins. Later an executive order of the President directed the Corps of Engineers to provide for the participation

of other interested Federal agencies and the affected states, through an inter-agency committee, in carrying out this assignment. On July 28, 1950, the first meeting of this inter-agency committee was held at Oklahoma City. The Governor and Director of the Colorado Water Conservation Board attended and this State will continue to participate in the work of this committee because of its interest in the Upper Arkansas River basin. At present the technical staff of the Water Board is engaged in matters which affect the State's interest in this investigation.

Laramie River: At the present time the staff of the Colorado Water Conservation Board is negotiating with Wyoming and interested water groups within the State to bring about, if possible, a more workable arrangement for the utilization of Laramie River waters. The United State Supreme Court decrees heretofore rendered with respect to the apportionment and use of these waters have resulted in intrastate problems between Colorado in-basin and out-basin users of Laramie River water. In an effort to make some permanent solution of these problems, it is necessary to reach, if possible, certain adjustments with the State of Wyoming. This work has entailed a number of conferences which are continuing, and also technical studies by the engineering staff of the Board.